SOIL BASICS and PASTURE RENOVATION in MENDOCINO COUNTY

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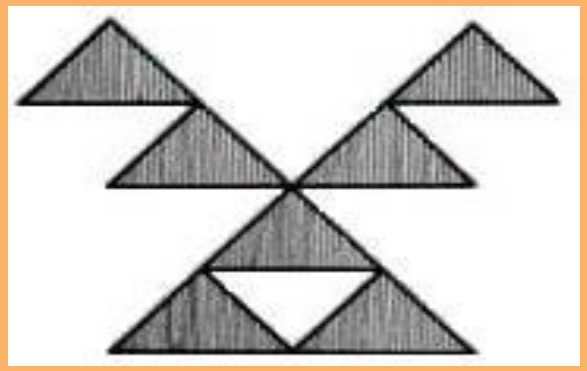


CLIMATE EFFECTS on SOILS

- Soils are created and moved by wind, rain, flowing water, heat, freezing & biological activity
- Amount of rainfall and when it occurs is a very important factor in soil formation
- Man's effects (acidification, organic matter depletion, fertilization, cover cropping) can speed up soil processes

DEFINITION OF SOIL DEVELOPMENT

- Soil formation is parent material, climate, vegetation, and organic matter working over time

Basic soil science:
What is happening here?

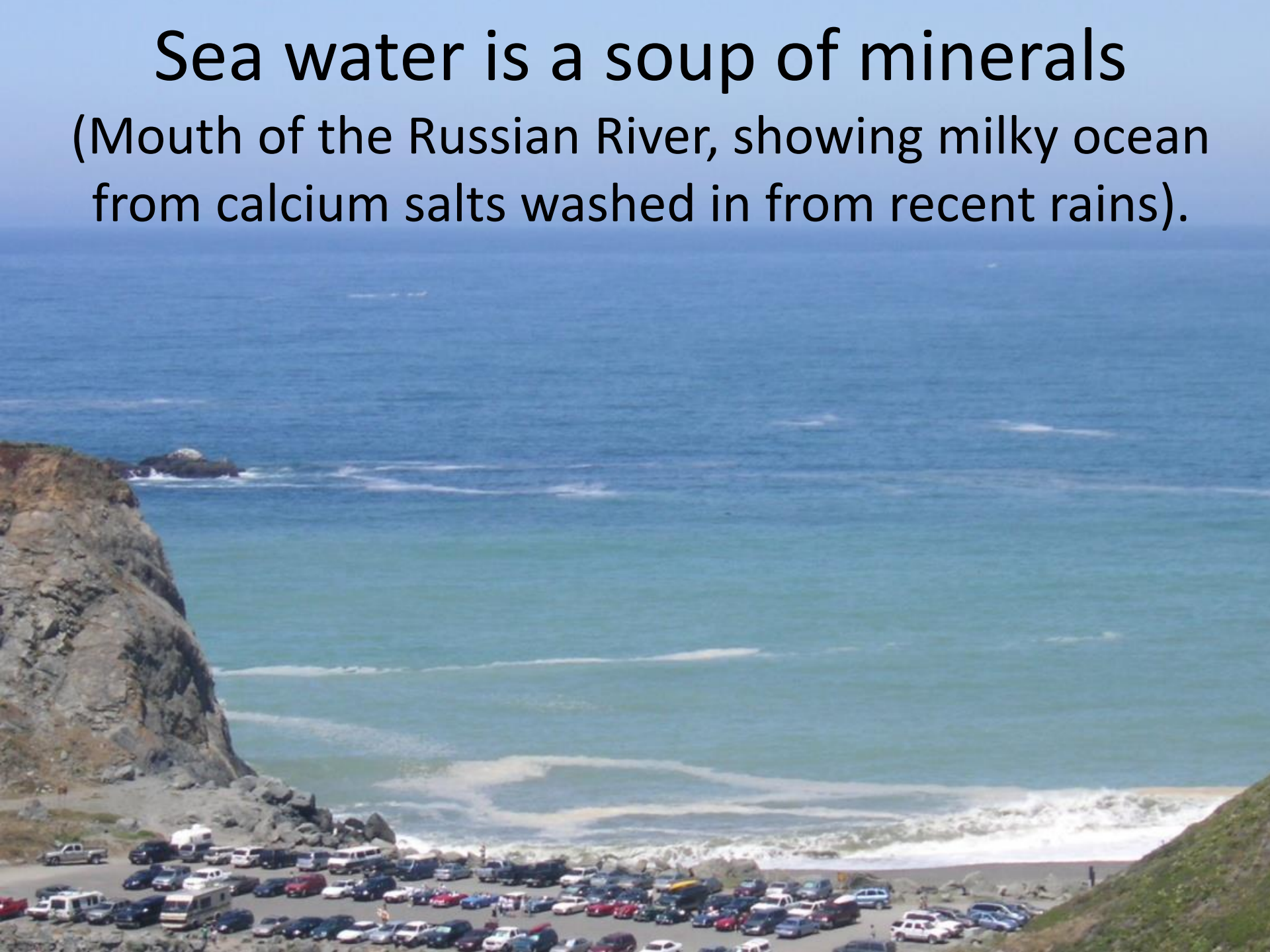
Typical River

Green River

Clear River

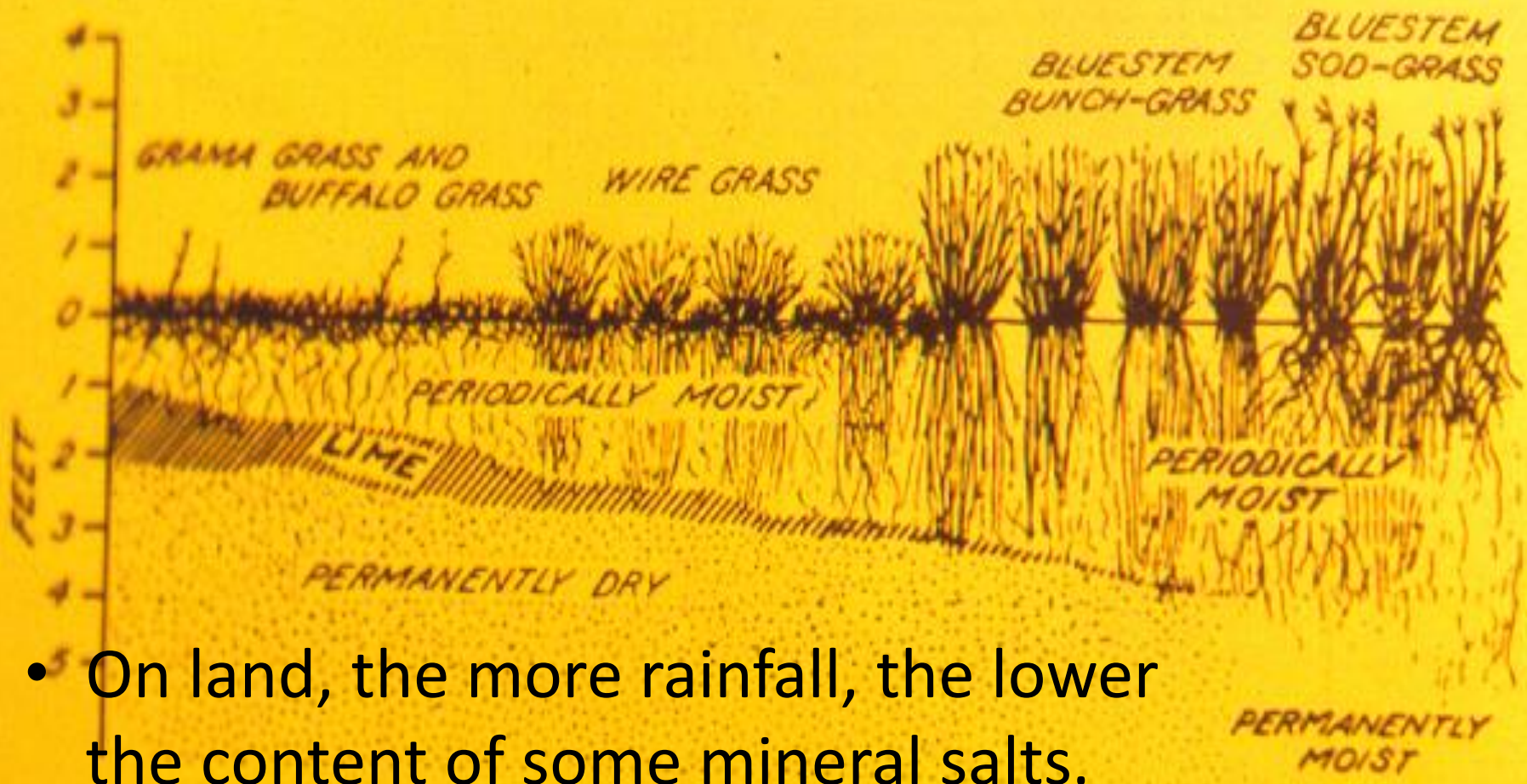
Sea water is a soup of minerals

(Mouth of the Russian River, showing milky ocean from calcium salts washed in from recent rains).



The following minerals are found in old lake or ocean deposits:

- Calcium carbonate (limestone)
- Sodium chloride (salt)
- Magnesium sulfate (Epsom's salt)
- Trace elements (boron, iron, etc.)



- On land, the more rainfall, the lower the content of some mineral salts.

Fig. 2.6

Relationship between vegetative growth and moisture supply along a west to east transect to the Great Plains. (From Shantz.[23])

Climate effects on soil formation & productivity

Appendix I

CLIMATE and SOIL FORMATION

FOREST	PRAIRIE/GRASSLAND	DESERT
HIGH RAINFALL: 20+ "	MEDIUM RAINFALL: 10 - 15 "	LOW RAINFALL: 0 - 5 "
PRECIPITATION > EVAPORATION	BALANCED PRECIP / EVAPORATION	EVAPORATION > PRECIPITATION
HI O.M. ACCUMULATION - Trees	O. M. ACCUMULATION - Roots	LOW O.M. ACCUMULATION
LEACHING OF MINERALS - Na, Ca, Mg, P_2O_5		ABUNDANCE OF NUTRIENTS - Ca, Mg, K, P_2O_5, excess salts
<< INCREASING ACIDITY	MEDIUM RANGE pH 7-8	INCREASING ALKALINITY >>
BICARBONATE (HCO_3) PRODUCTION	LOW ACIDITY - DISSOLVES NUTRIENTS	CARBONATE (CO_3) ACCUMULATION
CARBOHYDRATES - Wood, fruits	PROTEIN - forages, grains, legumes	PROTEIN w/ irrigation & salt leaching
SUPPORTS FEWER ANIMALS	HIGH ANIMAL PRODUCTION	LOW NATIVE ANIMAL PRODUCTION
NEEDS: Limestone; often major nutrients	Needs: Maintain fertility & organic matter	NEEDS: Water, O.M., leaching of excess salts, often micronutrients
UNDER DESTRUCTION	WELL DEVELOPED	UNDER CONSTRUCTION

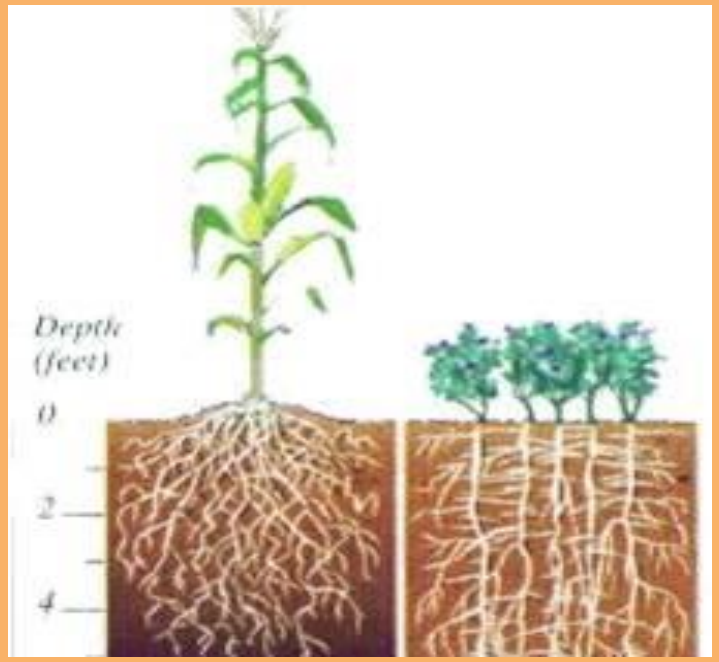
By Gregg Young, from Albrecht (1975)

To grow or produce highest amounts of protein (animal, seeds, nuts) the soils need the missing minerals in high rainfall areas. This is called re-mineralization.

Limestone applied to soil to raise calcium content

Legumes and High Protein Plants Need:

- Soils rich in potassium, calcium, phosphorus, sulfur, organic matter
- Without those conditions weeds (plants with poor grazing qualities) and other undesirable plants (noxious) tend to take over.



Example of a depleted pasture:

- Although animals leave manure behind, they eat 10 times what they leave
- Grazing is not fertilization

TYPICAL POTTER VALLEY SOIL:

- Low in calcium & potassium
- Good supplies of both needed for best growth of clovers
- Sulfur also needed
- Limestone needed at 1½ tons/ac, potassium sulfate at 1300 #/ac

Y&B AGRICULTURAL SERVICES
SOIL ANALYSIS

						Report No.	0851
Name	POTTER VALLEY TRIBE		Date Sampled	10/28/08		Soil Depth	0-12"
Field I.D.	MICHAEL CT		Crop	PASTURE/GRAZING		Soil Type	CLAY
% Organic Matter	6.0%	pH	6.8	CO_3		HCO_3	+
Cation Exchange Capacity (CEC)		22.1					

Soil Cations	Pounds/ac-ft Total	% CEC Present	% CEC Optimum	Pounds/ac-ft Required
Calcium (Ca)	12,424	70.2	65 – 75 %	1076
Magnesium (Mg)	2640	24.6	10 – 15 %	XS
Potassium (K)	480	1.4	3 – 5 %	1088
Sodium (Na)	160	0.8	0 – 5 %	
Hydrogen (H)	- - -	3.0	0 – 20 %	

Reserve Minerals:				
Calcium – $CaCO_3$ Equivalent	0	Phosphorus (P_2O_5)	1858	#/ac ft

Macro Nutrients	Pounds/ac-ft Present	Pounds/ac-ft Optimum	Micro Nutrients	Pounds/ac-ft Present	Pounds/ac-ft Optimum
Nitrate (N)	16	25-100	Zinc (Zn)	8.0	4-12
Phosphorus (P_2O_5)	469	150-250	Manganese (Mn)	40	36-48
Potash (K_2O)	576	1265-2116	Iron (Fe)	472	44-64
Sulfur (SO_4)	12	32 - 48	Copper (Cu)	16.0	3.6-4.8
			Boron (B)	4.4	2-4

LIMESTONE REQUIREMENT	1.3	Tons/ac ft	

TYPICAL COAST SOIL

- Very low in calcium
- Limestone needed at 1 ton per acre
- Sandy soil; needs lower rates of amendments

Y&B AGRICULTURAL SERVICES
SOIL ANALYSIS

				Report No.	1202
Name	POTTER VALLEY TRIBE	Date Sampled	2/15/12	Soil Depth	0-12"
Field I.D.	Ft Bragg Mid Pasture	Crop	Pasture – Livestock	Soil Type	Sand
% Organic Matter	2.7%	pH	5.7	CO_3	
				HCO_3	+
Cation Exchange Capacity (CEC)	3.9				

Soil Cations	Pounds/ac-ft Total	% CEC Present	% CEC Optimum	Pounds/ac-ft Required
Calcium (Ca)	1668	52.8	65 – 75 %	732
Magnesium (Mg)	328	17.1	10 – 15 %	
Potassium (K)	408	6.6	3 – 5 %	
Sodium (Na)	88	2.5	0 – 5 %	
Hydrogen (H)	- - -	21.0	0 – 20 %	

Reserve Minerals:				
Calcium – $CaCO_3$ Equivalent	0	Phosphorus (P_2O_5)	129	#/ac ft

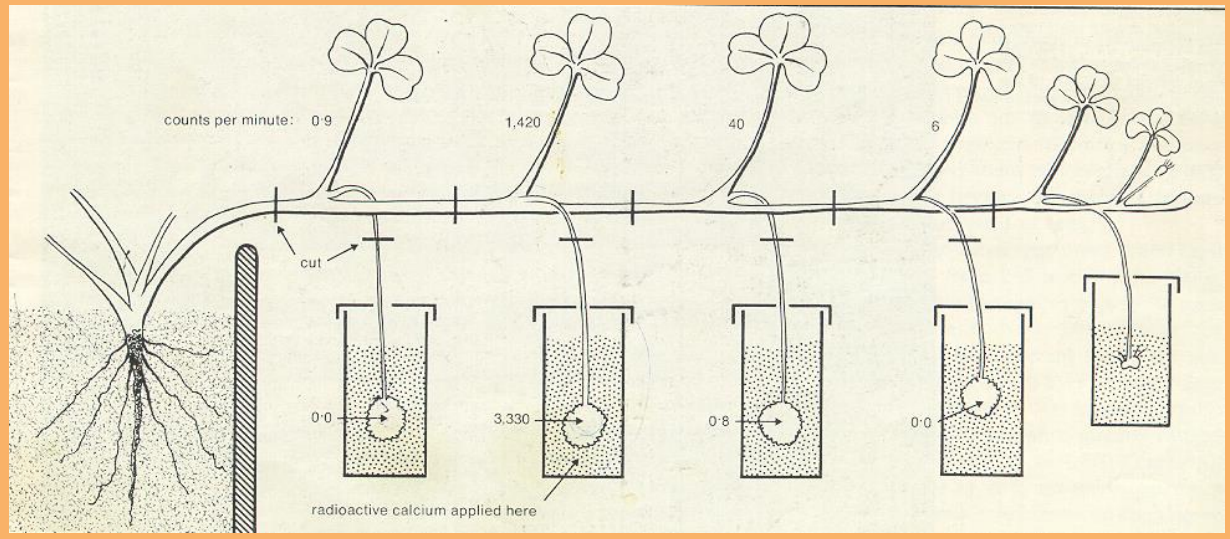
Macro Nutrients	Pounds/ac-ft Present	Pounds/ac-ft Optimum	Micro Nutrients	Pounds/ac-ft Present	Pounds/ac-ft Optimum
Nitrate (N)	12	25-100	Zinc (Zn)	25.2	4-12
Phosphorus (P_2O_5)	74	150-250	Manganese (Mn)	36	36-48
Potash (K_2O)	490	432-374	Iron (Fe)	74	44-64
Sulfur (SO_4)	60	32 - 48	Copper (Cu)	0.8	3.6-4.8
			Boron (B)	1.6	2-4

LIMESTONE REQUIREMENT	1.0	Tons/ac ft	

A Sustainable Soil Building Program

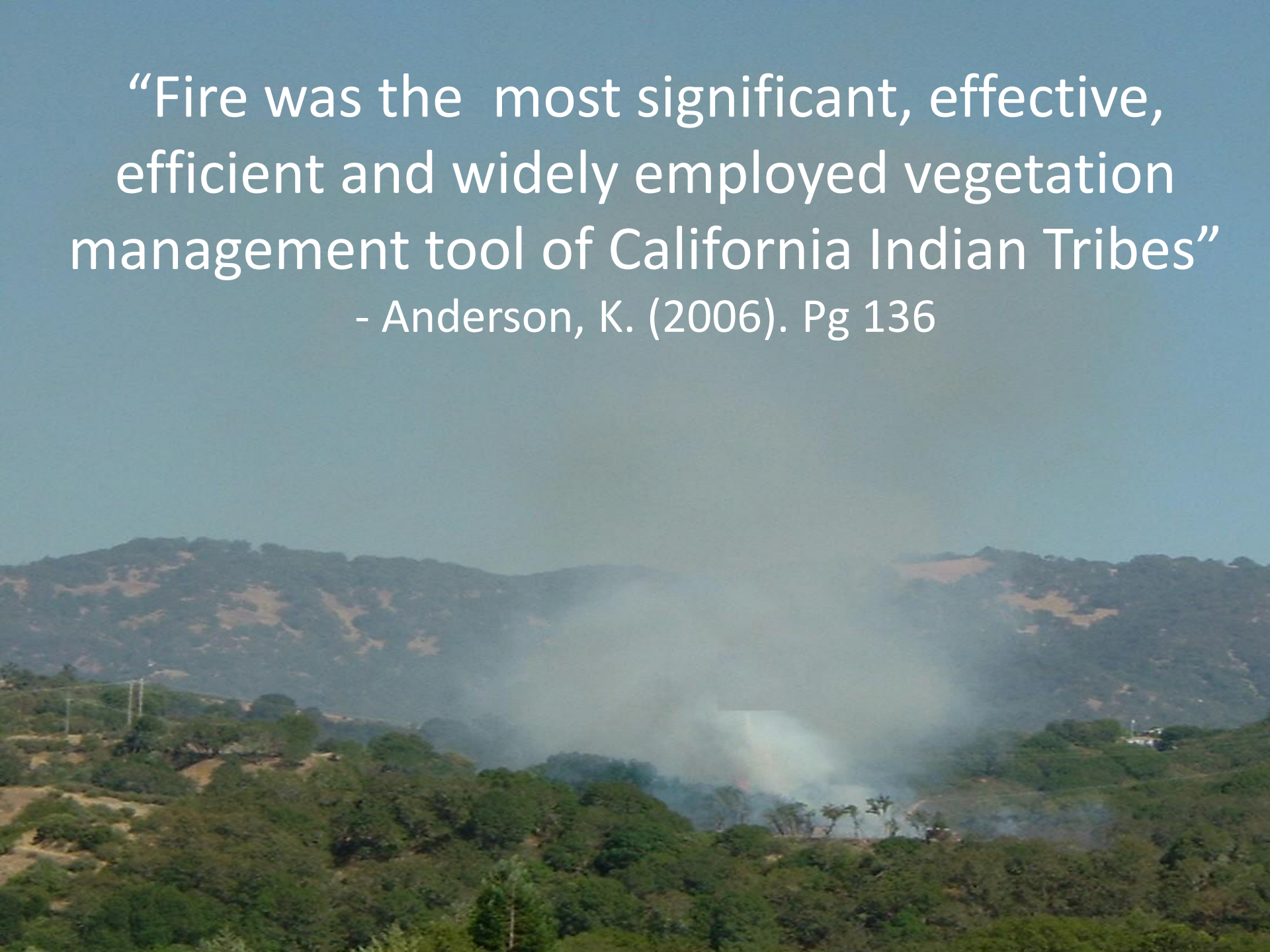
- Apply nutrients & amendments according to what the soils need for best production
- Can be spread over several years, as long as you are:
  - Replacing what is removed by the cropping system (minimum program)
  - Headed in the right direction (sensible program)

Calcium is needed for clover seed production and germination



Did Native Americans know this?

- They managed natural resources on a sustainable level.
- They used natural forces: fire, weather & vegetation to manage resources to their advantage.
- They generally recognized when resources were becoming scarce, and moved to new areas, limited harvests, or changed practices.
- Among the techniques of traditional resource management: burning, irrigating, pruning, sowing, tilling, and transplanting


“Fire was the most significant, effective, efficient and widely employed vegetation management tool of California Indian Tribes”
- Anderson, K. (2006). Pg 136

EFFECTS of FIRE

- Reduces organic matter to its mineral constituents (calcium, potassium, magnesium, phosphorus, sodium, sulfurs, micronutrients)
- Eliminates pests, diseases and unwanted plants
- Stimulates growth of perennial plants and forages
- Stimulates nitrogen fixing bacteria (free-living and nodule/legume)
- Improves game productivity and protein production
- Thins understory of forests, resulting in larger, faster growing trees & shrubs

What's in the Ash from an Acre of Chaparral? (in pounds/acre)

Element	Red shank	Chamise	Ceanothus	Black sage	TOTAL (+ misc)
Calcium	52	48	78	12	211
Nitrogen	33	24	50	8	121
Potassium	30	18	33	21	102
Magnesium	6	3	5	2	17
Phosphorus	4	2	2	2	10
Sodium	3	1	2	1	8